THE ROYAL AERONAUTICAL SOCIETY

WITH WHICH IS INCORPORATED THE INSTITUTION OF AERONAUTICAL ENGINEERS

MONTHLY NOTICES

MAY, 1942.

Wilbur Wright Memorial Lecture.

The 30th Wilbur Wright Memorial Lecture will be read on Thursday, May 28th, 1942, at 6.30 p.m., by Lieut.-Colonel the Rt. Hon. J. T. C. Moore-Brabazon, M.C., F.R.Ae.S., Vice-President of the Society. The title of the lecture will be "Ad Astra," and it will be held at the Institution of Mechanical Engineers, Storey's Gate, St. James's, S.W.1 (by kind permission of the Council of the Institution). Light refreshments will be served before the meeting.

Associate Fellowship Examinations.

The next Associate Fellowship Examinations will be held on Tuesday, May 19th, and Wednesday, May 20th, 1942. Full particulars of place and time will be sent direct to candidates who have entered for the examination.

Associate Fellowship New Syllabus Postponement.

The Council at their last meeting had under consideration the introduction in May, 1943, of the new syllabus for the Associate Fellowship examinations. Notice was given some two years ago of the provisions of the new syllabus, but the increasing difficulties created by the war situation has caused the Council to decide to defer putting the new syllabus into operation until at least six months after the cessation of hostilities. The present syllabus will therefore be continued until further notice.

Any student who has been preparing for subjects, however, which appear in the new syllabus and not the old, will have a paper set in that subject, so he will not be penalised.

It should be noted that in agreement with other engineering institutions, it will be necessary before the examinations are taken, to have passed the Common Preliminary Examination or to have passed an exempting examination. Section A of the present syllabus is abolished as from January 1st, 1943.

Journal and Paper Shortage.

Many members of the Society working in official establishments or in firms have opportunities of seeing the Journal apart from the copy to which they are entitled. The severe shortage of the supply of paper is making the printing of the Journal more and more difficult and it has been suggested that those members who can otherwise see the Journal may be prepared to give up their own copy for the period of the war. If a sufficient response is received to the suggestion it will

enable the Journal to keep closely to the standard it has set. It may have the further effect of enabling some reduction to be made in the subscriptions of those who do not receive the Journal, though this a matter for final decision of the Council after the position has been reviewed and cannot be looked upon as a foregone conclusion.

Advertisements.

The fact that goods made of raw materials in short supply, owing to war conditions, are advertised in the Journal should not be taken as an indication that they are necessarily available for export.

Graduates' and Students' Section.

The following meetings have been arranged for the Graduates' and Students' Section to be held in the Library of the Society at 4, Hamilton Place, W.1, at 7.30 p.m. (not 7 p.m. as announced in last month's Journal). Senior members of the Society are invited to the lectures and non-members wishing to attend must apply in writing to the Secretary of the Society.

May 27th.—Lecture by Mr. R. N. Hadwin on " Experimental Vibration Work in Aircraft."

June 17th.—Lecture by Mr. F. H. M. Lloyd, A.F.R.Ae.S., on " The Design of Fighter Aircraft."

Elliott Memorial Prize.

The Elliott Memorial Prize was presented on March 25th, 1942, to Aircraft Apprentice H. H. J. Pidgeon, who obtained the highest marks in the March, 1940, entry of Aircraft Apprentices.

Endowment Fund.

The Council acknowledge with grateful thanks the gift of 7s. 0d. to the Endowment Fund from Warrant Officer J. V. Saunders, Associate Fellow.

Election of Members.

The following members have recently been elected:—

Associate Fellows.—William Howard Wesley Bell (from Associate), Edmond Laidler Chapman, Robert Grant, Ralph Marcus Hare (from Graduate), Frank Jefferson Horn (from Student), Charles Edward Hurt, Robert Laurence Morrison (from Associate), Edwin Pribram, Harold Yendall.

Associates.—William Deryk Castello, Vivian James Chalwin (from Student), Leslie Ewart Goodman, Richard Frederick Samuels, Henry George Anthony Scilley, William Swallow, Kenneth Watson, Hubert Edward Whatley, James Williamson.

Graduates.—Ernest Geoffrey Collinson, John Richard Densham. Arthur Sherlock Foreman, Reginald Jackson, Raymond Lloyd Jefferies, Francis Nicolas Kirk (from Student), David McCausland, Kenneth John Spooner (from Student), George Edward Stanway, Richard Ivor Beaumont Tavener, Geoffrey Robert Venn-Brown.

Students.—Older Francis Hawkins Borley, Richard Hall Brand, George Callas, William Donald Gregson, Leonard Hutton, Allan Stuart McGregor, Charles William Massey, John Parkinson, Clive Westgarth Simpson, John James Spillman.

Companions.—Frederick Aneurin Connop Behenna, Thomas Ralph Brown, Charles Southgate.

COPY.

Income Tax.

In response to numerous inquiries with regard to a rebate on Income Tax for their subscriptions, the following is a copy of a letter received from the Principal Inspector of Taxes:—

" Ref. H.R.S. 34/C.I. 4420/63.

Dear Sir,—Further to your interview with Mr. Stonely at this office on the 19th July, I am now in a position to inform you that the Board of Inland Revenue will not raise objection to the allowance as an expense for Income Tax purposes of annual subscriptions paid by members who are:—

(i) Assessable under Schedule D of the Income Tax Acts in respect of professional or trading profits, subject to the decision of the Commissioners who make the assessment that such subscriptions are sufficiently closely related to the business carried on. or

(ii) Assessable under Schedule E in those cases only in which continual membership of the Society is an essential condition of the terms of appointment.

Yours faithfully,

(Signed) GEO. WILCOCK,

Principal Inspector of Taxes."

Correction.

In the review of " Aircraft Stressing," page 108, the author's name was given as W. L. Moore. This should be W. L. Morse.

Additions to the Library.

Pamphlets in italics with location reference following in brackets.

Books marked * or ** may not be taken out on loan.

*B.a.251-253.—*Specifications of Enemy Aeroplanes (German, Italian, Japanese). Air Ministry.* 1942. (*Press release: stencil.*) Y.3.ii.G, I, J.)

B.d.2.—Ark Royal. By Sir Herbert Russell and Commander H. Pursey. John Lane, The Bodley Head. 1942. 4/6.

E.a.12.—Understanding Basic Engineering by Question and Answer. By W. Hazell. English Universities Press. 1942. 2/6.

*G.b.3.—*British Standards Institution*:—

A.19, Part 2. " Go " and " Not go " Caliper Gauges for Serrations.

A.19, 2SP.3, SP.7, SP.8: Modification Slips.

Sectional List of British Standards to April, 1942.

G.e.A.75.—Aluminium Engineering Sections. The Aluminium Union, Ltd. 1939.

G.e.A.76.—Aluminium Alloys. The Aluminium Union, Ltd. 1939.

G.e.A.77.—Aluminium Technique. (Issues 2-8, 10-14.) The Aluminium Union, Ltd. 1939-1940.

G.f.26.—The Welding and Riveting of Aluminium. (2nd Ed.) The Aluminium Union, Ltd. 1940.

J.b.13.—*India Meteorological Department. Scientific Notes*:—

Vol. VIII, No. 98. Forecasting the " North-east Monsoon " rainfall of South Madras. By V. D. Iyer. Manager of Publications, Delhi. 1941. 7d.

K.a.18.—*The Propagation of Sound to Great Distances. (Reprint from Journal of the Royal Meteorological Society, July,* 1935.) *By F. J. W. Whipple.* (PK.1.a.7.)

K.a.19.—*The Temperature in Summer of the Upper Atmosphere as indicated by the Study of Airwaves. (Reprint of Lecture before the Association de Météorologie, Lisbon, Sept.,* 1933.) *By F. J. W. Whipple. P. Dupont, Paris.* 1935. (PK.1.a.8.)

L.a.42.—How to Pilot an Aeroplane. By Norman Macmillan. Allen and Unwin. 1942. 2/6.

L.d.74.—Navigation and Meteorology. By D. Hay Surgeoner. Longmans, Green and Co. 1942. 3/6.

Q.b.64.—Carnegie United Kingdom Trust: 28th Annual Report (1941).

R.f.76.—*Q.A.N.T.A.S. Empire Airways Gazette, December,* 1941. (*Special anniversary number, giving historical survey of the Company,* 1919-1941.) (Y.11.iv.a.25.)

S.e.33.—Cañada's Wings. By Peter J. Field. John Lane, The Bodley Head. 1942. 4/-.

*UU.c.—*National Advisory Committee for Aeronautics (U.S.A.): Technical Memoranda*:—

No. 1,005. The stresses in Stiffener Openings. By K. Marguerre. (From Luftfahrtforschung, July, 1941.)

**Z.f.21 (M).—*Programme*: " *Grandes Fiestas de Aviación en Malaga. 28 de Agosto-1° de Septiembre,* 1910."

J. Laurence Pritchard, *Secretary and Editor.*

AIRSCREWS FOR HIGH-SPEED AIRCRAFT.*

F. WEINIG.

(*Luftfahrtforschung, Vol.* 14, *No.* 4-5, 20/4/37, *pp.* 168-172.)

Translated by M. FLINT.

The high engine output necessary in order to effect further increases in flight speed must be transformed in the fullest possible measure by the airscrew into propulsive power. Three possibilities are open whereby the capacity of the airscrew for absorbing the engine power may be increased, namely, (1) by increasing the diameter, (2) by increasing the number and width of the blades, and (3) by increasing the peripheral speed. The increase in the diameter is limited by the effects of weight, the increase in the number and width of the blades by considerations of structure and design and the increase in the peripheral speed by the speed of sound. Of these limitations the last is of particular importance.

CONTENTS.

I. The limitation of the airscrew tip speed by proximity to the speed of sound.

II. The need for reducing the peripheral speed with the increase of the flight speed.

III. Aerodynamic behaviour of airscrews with large " advance ratio " ($\lambda = v/u$) and large " performance coefficient " (k_a).

IV. The suitability of airscrews in opposed rotation.

I. THE LIMITATION OF THE AIRSCREW TIP SPEED BY PROXIMITY TO THE SPEED OF SOUND.

There are diverse ways by which the speed of aircraft can be increased. Besides the improvement of the aerodynamic form and the reduction of the structure weight in relation to the useful load, one of the most important is the increase in the engine power. The duty of the airscrew then is to transform this power in the best and fullest possible measure into propulsion.

The means whereby the performance of the airscrew may be increased are:—

1. Increase of the diameter.
2. Increase of the number and width of the blades
3. Increase of the peripheral speed.

That the diameter of the screw and the number and width of the blades are in some way limited is immediately comprehensible, but at the same time it is apparent that there is still some way to go before these limits have been reached in practice.

This does not apply to the peripheral speed, or more exactly, to the tip speed of the airscrew.

In this case a definite limit is set by the speed of sound. In fact even before the speed of sound is reached a marked drop in the airscrew efficiency may be observed.

Since the demand for high speed is mostly coupled with the desire for flight at high altitudes, it is useful to know that the speed of sound decreases with

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* Published by permission of the Ministry of Aircraft Production, R.T.P.

increasing altitude, this being due to the decrease in temperature with height. In metres per second, the speed of sound is:—

$$w_s = 20.1\sqrt{T}$$

where T is the absolute temperature in degrees, hence

$$T = 273° + t$$

t being the temperature in °C. In Fig. 1 the speed of sound is shown as a function of the flying altitude.

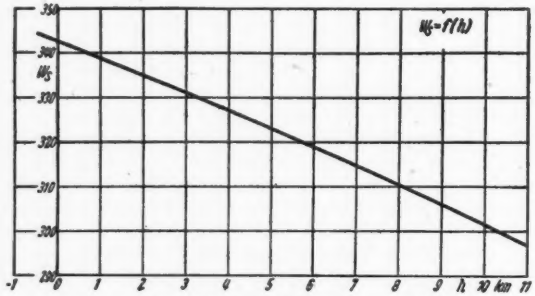

Abb. 1. Abhängigkeit der Schallgeschwindigkeit von der Flughöhe (JNA).

FIG. 1.

Speed of sound as a function of the flying altitude (standard atmosphere).

The tip speed w of the screw is obtained as the resultant of the flight speed v and the peripheral speed u

$$w = \sqrt{(v^2 + u^2)}$$

If η_{Po} is the efficiency of the airscrew for a given advance ratio λ with small peripheral speed, the efficiency with large u may be written:—

$$\eta_P = \eta_{Po} \cdot \eta_u$$

η_u thus takes the influence of the peripheral or tip speed of the screw on the efficiency into consideration. Now η_u depends not only on the Mach number of the screw $M_s = w/w_s$, the ratio of the tip speed to the speed of sound, but also on the mean lift coefficient c_a or rather on a value $\bar{c}_a = c_a\,(1+\lambda^2)^{3/2}$ of the airscrew blade.

By a rational development of the mean value we may write:—

$$\bar{c}_a = c_a\,(1+\lambda^2)^{3/2} = \left(\frac{2\pi R}{z t_m}\right)\left(\frac{k_s}{2/3}\right), \text{ or with } \left(\frac{z t_m}{2\pi R}\right) = \chi;$$

$$\bar{c}_a = \left(\frac{3}{2}\right)\left(\frac{k_s}{\chi}\right)$$

where R = radius of the airscrew, z = number of blades.

$$t_m = \int_0^1 t\,d\left(\frac{r}{R}\right)^4 = \text{mean width of blade} \begin{cases} r = \text{arbitrary screw radius.} \\ t = \text{width of blade at an arbitrary position.} \end{cases}$$

$$k_s = \frac{S}{\frac{1}{2}\rho u^2 \pi R^2} = \text{thrust coefficient} \begin{cases} S = \text{airscrew thrust.} \\ \rho = \text{air density.} \end{cases}$$

$$\lambda = \frac{v}{u} = \text{“ advance ratio.”}$$

Further we may use:—

$$k_d = \frac{N}{\frac{1}{2}\rho u^3 \pi R^2} = \text{performance coefficient } (N = \text{performance}).$$

The suffix o will be used to denote the same quantities with small peripheral velocity but the same advance ratio.

Evaluation of experimental results on full-size airscrews and with values of λ up to 0.15 and on the test bench provided, in the sub-critical Mach range, the relations:—

$$\left.\begin{aligned} k_s &= k_{so} \cdot e^{\kappa_s \left(\frac{w}{w_s}\right)^4 \left(\frac{k_{so}}{\chi}\right)} \\ k_{\ddot{a}} &= k_{do} \cdot e^{\kappa_{\ddot{a}} \left(\frac{w}{w_s}\right)^4 \left(\frac{k_{so}}{\chi}\right)} \\ \eta_u &= \frac{1}{e^{\kappa \left(\frac{w}{w_s}\right)^4 \left(\frac{k_{so}}{\chi}\right)}} \end{aligned}\right\} \quad \begin{aligned} \bar{c}_a &= \bar{c}_{ao} e^{\kappa_s \left(\frac{w}{w_s}\right)^4 \left(\frac{k_{so}}{\chi}\right)} \\ &= \bar{c}_{ao} e^{\left(\frac{2}{3}\right) \kappa_s \left(\frac{w}{w_s}\right)^4 \bar{c}_{ao}} \end{aligned}$$

Whilst the relation given for $k_{\ddot{a}}$ holds up to very high, in practice also for a region of super-critical, values of w/w_s, the relation given for k_s and hence also for η_u holds only for a critical value, above which k_s and hence also η_u very rapidly decrease. This limit is governed by the thickness ratio of the profiles and by the c_a value.

The experimental results failed to reveal any dependence of the coefficients κ_s, $\kappa_{\ddot{a}}$, κ_η on the profile form, thickness ratio or blade width distribution. In the case of metal airscrews the experimental results could be uniformly and quite satisfactorily represented by the values:—

$$\kappa_s = 0.603$$
$$\kappa_{\ddot{a}} = 0.410$$
$$\kappa_\eta = 0.193$$

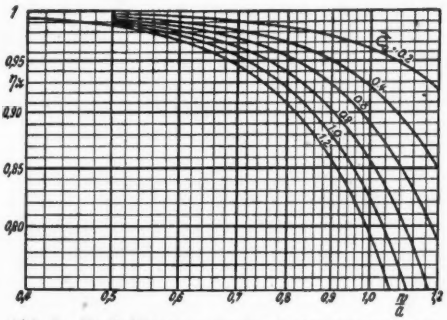

Abb. 2. Einflußfaktor η_u der Umfangsgeschwindigkeit auf den Wirkungsgrad.

FIG. 2.

Factor of influence η_u of the peripheral speed on the efficiency.

In Fig. 2 η_u is shown for a few c_a values as a function of w/w_s. For the direct application of the given relations, however, the nomogram shown in Fig. 3 would seem to be more useful. This enables η_u to be determined directly from the diameter, r.p.m., flight speed, flying altitude and c_a value.

II. The Need for Reducing the Peripheral Speed with the Increase of the Flight Speed.

As the tip speed w is the resultant of the peripheral speed u and the flight speed v, it is found that on increasing v, u must be kept continuously smaller if a definite tip speed w is not to be exceeded. The dependence of the permissible

Abb. 3. Nomogramm zur Bestimmung von η_u.

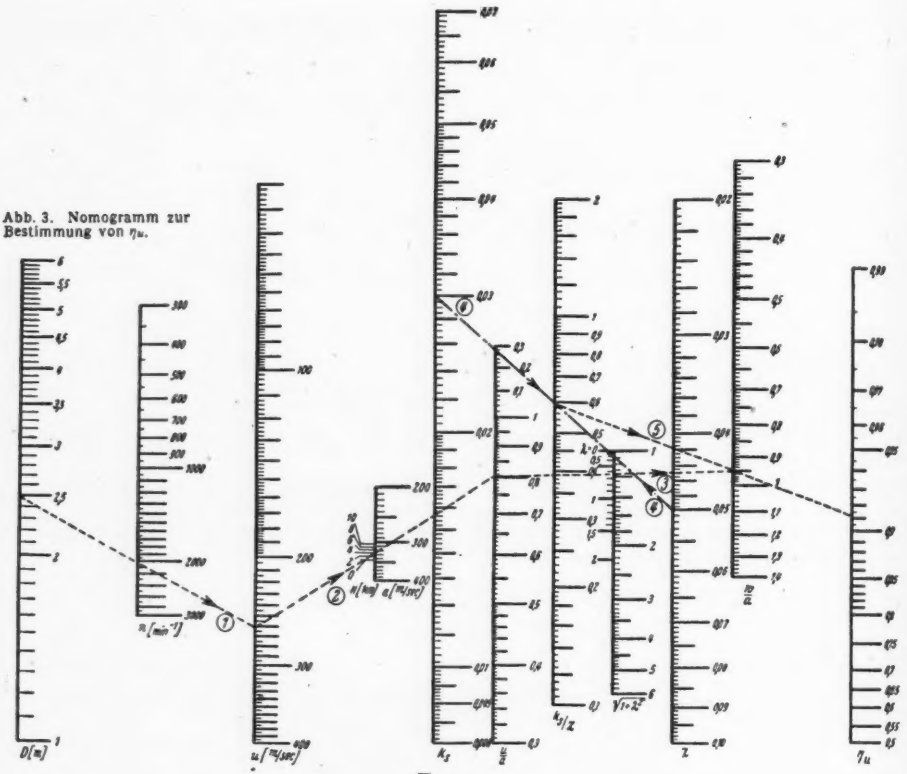

FIG. 3.

Nomogram for the determination of η_u.

Abb. 4 (links) Abhängigkeit der Spitzengeschwindigkeit von Flug- und Umfangsgeschwindigkeit

Abb. 5 (rechts). Abhängigkeit der Umfangsgeschwindigkeit für $M_u = 0{,}90$ von der Fluggeschwindigkeit und der Flughöhe.

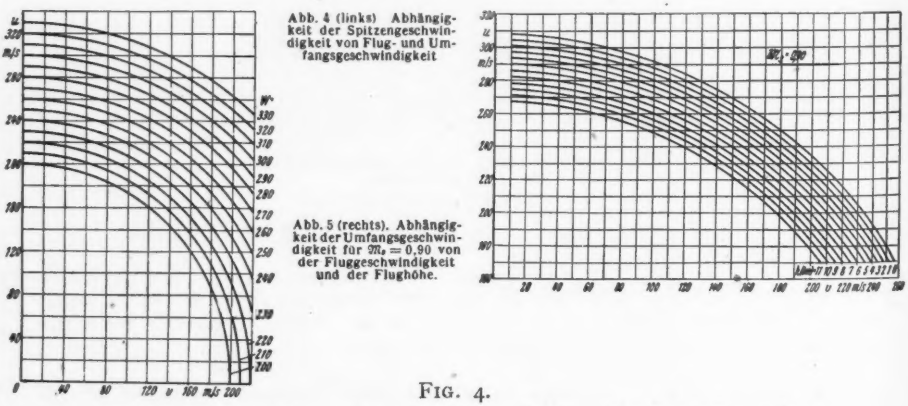

FIG. 4.

(*Left.*) *Tip speed as a function of the flight and peripheral speeds.*

FIG. 5.

(*Right.*) *Peripheral speed for* $M_u = 0.90$ *as a function of the flight speed and of the flying altitude.*

peripheral speed with a given tip speed w on the flight speed v is shown graphically in Fig. 4.

If, for example, a tip speed of $w=285$ m./s. is to be permitted at high speed flight at $v=200$ m./s., the peripheral speed may be only $u=203$ m./s.

The question may now perhaps be asked whether, with the same airscrew in the climb at, say, $v=80$ m./s., a higher peripheral speed should be permitted, since for $v=80$ m./s. and $u=203$, w will be $=218$ m./s. In itself this might be useful, since during the climb the flying altitude is lower, and the speed of sound therefore is greater and hence a higher w will be permissible than in flight at high speed at a greater altitude, and since the lift coefficient of the airscrew blade, which would otherwise be greater than in the high speed flight, would be greatly reduced by increasing the r.p.m. An increase of the peripheral speed for climbing, for example, by a multi-stage gear, however, would probably not be worth while. Matters are different during the take-off with a variable pitch

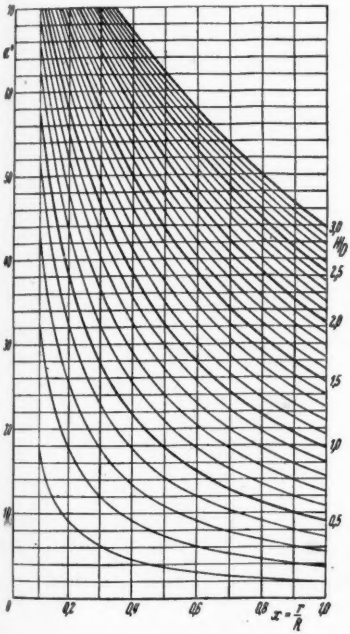

Abb. 6. Steigungswinkelverlauf für Schrauben konstanter Steigung.

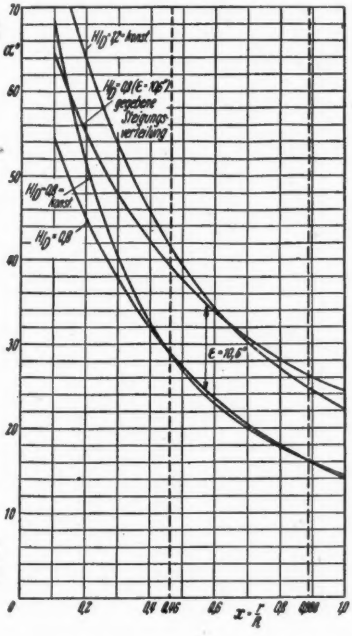

Abb. 7 (rechts). Beispiel für die Bestimmung der Null-Steigung H_0/D einer Schraube bei vorgegebenem Steigungswinkelverlauf.

FIG. 6.

Distribution of the pitch angle for screws of constant pitch.

FIG. 7.

(Right.) Example for the determination of the zero pitch H_0/D of a screw with specified distribution of pitch angle. Gegebene Steigungsverteilung = given pitch distribution.

airscrew, when with the same r.p.m. as in the high speed flight diversion of the air flow would have to be taken into consideration. Here an increase of the r.p.m. by a multi-stage gear might, in some circumstances, be a considerable advantage.

From the decrease of the speed of sound with altitude and the decrease of the ratio of peripheral to tip speed with increasing flight speed, however, it is to be inferred that the peripheral speed with given Mach number must decrease con-

tinuously with increasing flying altitude and speed. This appears clearly from Fig. 5. Since therefore with increasing flight speed v and flying altitude H, no increase but a decrease in the peripheral speed u is to be anticipated in the further development of aircraft, the factor $\lambda = v/u$ in high speed flight will increase sensibly with this development.

III. Aerodynamic Behaviour of Airscrews of Large λ and Large k_d.

If the airscrew is to conform in high-speed flight to the large λ, its design pitch in itself must be correspondingly large. As the airscrew must be effective also in the take-off and in the climb, it must in general also be of variable pitch. We shall therefore first consider the distribution of the pitch angle over the radius as a function of the pitch ratio in the case of constant pitch, Fig. 6. Now if an airscrew blade is turned or " set " by a constant angle, the distribution of pitch over the radius is no longer constant. We now assume that we have the distribution of the pitch angle of a screw with a certain adjustment (Fig. 7). How would it have to be re-set so that it could be regarded at least approximately as a screw of constant pitch? A consideration of mean values will show that satisfactory results can be obtained by setting the airscrew in such a way that

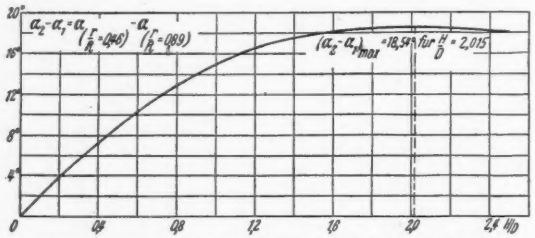

Abb. 8. Unterschied der Steigungswinkel einer Schraube konstanter Steigung in $r = 0{,}46\ R$ und $r = 0{,}88\ R$.

In Abb. 9 und Abb. 10 sind die Versuchsergebnisse mit zwei vierflügeligen Schrauben wiedergegeben. Das Blattbreitenverhältnis war bei beiden Schrauben nahezu gleich.

Fig. 8.

Difference in the pitch angles of a screw of constant pitch at $r = 0.46\ R$ and $r = 0.88\ R$.

the pitch angles at $r/R = 0.460$ and $r/R = 0.888$ are in agreement with the pitch angles of a screw of constant pitch. The airscrew under consideration is therefore set about 10.6° and has a design pitch ratio $H_0/D = 0.8$, whilst its effective pitch ratio, which can be determined approximately from the conditions at $r/R = 0.7$, is roughly $H/D = 1.3$.

For the reason explained, it is desirable to know the difference in the pitch angle of a screw of constant pitch at the radii $r/R = 0.466$ (*sic*) and $r/R = 0.888$. This is shown in Fig. 8.

From this it is seen that this difference in pitch angle has a maximum value at $H/D = 2.015$, so that airscrews with an initial pitch ratio in the neighbourhood of this value must be highly insensitive to setting.

The experimental results obtained with two four-bladed screws are given in Figs. 9 and 10. The blade width ratio in both cases was practically the same.

$$\frac{zt_{(0.7)}}{2\pi R} = 0.0669, \qquad \frac{zt_m}{2\pi R} = 0.0514.$$

The initial pitch ratio in the case of the screw referred to in Fig. 9 was $H_0/D \sim 1.00$, and in Fig. 10 $H_0/D \sim 2.00$. These screws were progressively

set $\pm 4°$ at a time. The efficiencies, apart from the region with flow diversion, were approximately equal. The experiments showed further, that the power input with the same pitch angle is almost the same at $r/R=0.7$.

The reason why the differences in power are so small lies in the fact that the difference of the twist of the airscrew blades between $r/R=0.460$ and $r/R=0.888$ is not quite $4°$ and that owing to the reciprocal influence of the blade sections, as in the case of the aerofoil, the distribution of effective incidence with the same loading is obviously still further balanced.

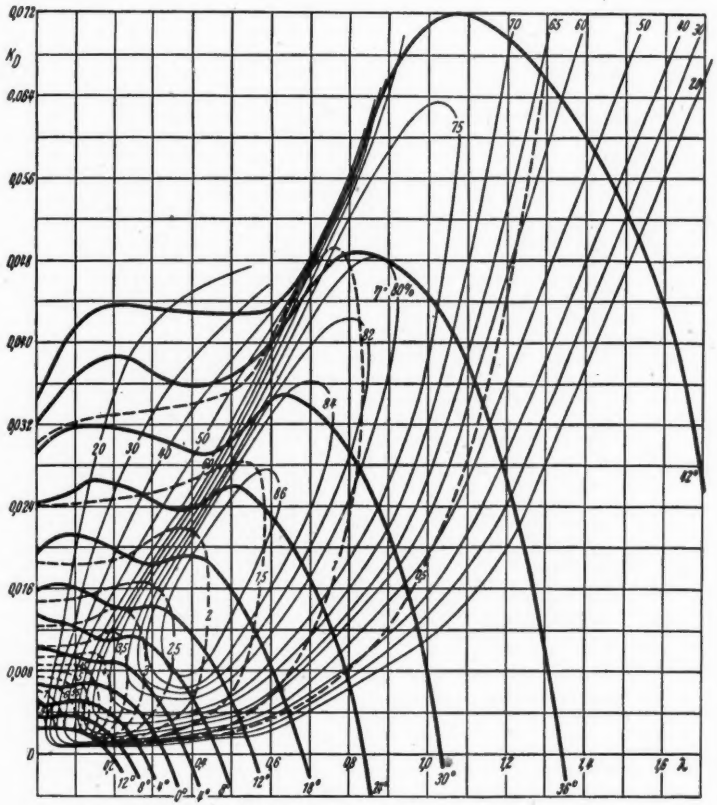

Abb. 9. Versuchsergebnisse mit einer vierflügeligen Schraube $H_0/D=1$.

FIG. 9.

Experimental results obtained with a four-bladed screw $H_0/D=1$.

The conditions become different, however, as is revealed in particular by the efficiencies, in the region of flow diversion. For this reason, owing to the necessities on taking-off, a screw with smaller initial pitch would appear to be more suitable than one of large initial pitch.

If in high-speed flight, values of λ sensibly exceeding 0.7 have to be permitted it is found from the equality of the difference of the pitch angle, at $r/R=0.460$ and $r/R=0.887$ for a value of $H_0/D > 2.015$ and $H_0/D < 2.015$, that the simultaneous adaptation of the screw to high-speed flight and to climbing conditions with suitable adjustment again becomes easier. If, for example, for the high-

speed flight a pitch ratio $H_o/D=3.0$ is required and for the climb $H_o/D=1.2$, the pitch angle distribution necessary for constant pitch would be that shown by the full line in Fig. 11. If the distribution represented by the dash-line is selected, in both cases the same pitch angle $\epsilon=12°$ will be obtained. This distribution, however, conforms to a large extent to the distribution of constant pitch which is essentially favourable for both conditions of flight. In both conditions of flight therefore such a screw may be expected to give good performance. The distribution of the pitch angle of a better compromise screw is shown by the dot-dash line in Fig. 11.

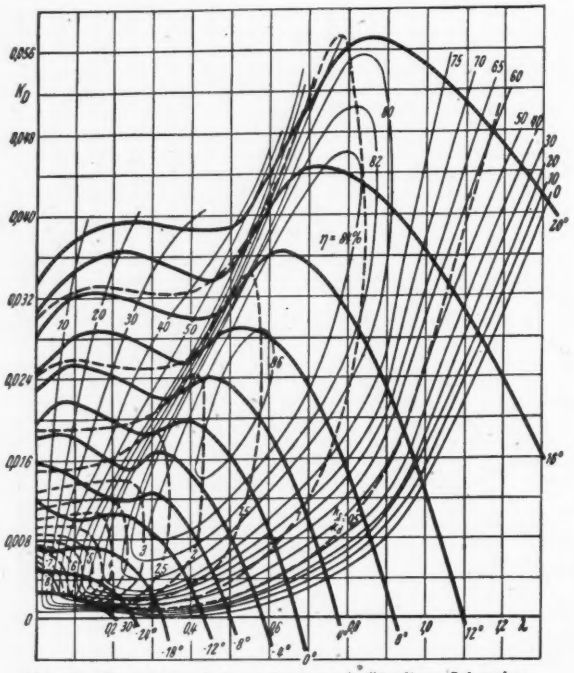

Abb. 10. Versuchsergebnisse mit einer vierflügeligen Schraube $H_o/D=2$.

FIG. 10.

Experimental results obtained with a four-bladed screw $H_o/D=2$.

IV. The Suitability of Airscrews in Opposed Rotation.

Let us now consider the problem when there is 1,600 h.p. to be disposed of by each of two screws at a flight speed of $v=200$ m./s. $=720$ km./hr. at an altitude of $H=5{,}000$ m. First a blade-width ratio χ is selected in such a way that it corresponds to a value suitable in high-speed flight.

$$\bar{c}_a=\frac{3}{2}\frac{k_s}{\chi}=\frac{3}{2}\frac{\eta}{\lambda}\frac{k_a}{\chi}$$

Next a few diameters and r.p.m. values are selected and, using experimental results obtained with small u, we determine the efficiency for each pair of values (D, n). Multiplying by the values of η_u corresponding to the selected c_a, we then obtain the efficiency of the screw which, under some circumstances must still be multiplied by the efficiency when mounted, in order to obtain the actual factor of quality of the propulsion. We thus find the dependence of the propul-

sive efficiency on the r.p.m. and the diameter. Now it would be an unsuitable choice to select that pair of values (D, n) corresponding to the maximum value. From the point of view of the climb it would be better to select a slightly larger diameter and slightly smaller r.p.m. provided that, taking weight, height of undercarriage and similar factors into consideration, this is possible. Let $n=890$ be the r.p.m. and $D=4.50$ m. the diameter selected. The torque of each screw will then be

$$M_d=716.2\frac{N}{n}=1{,}290 \text{ m. kg.}$$

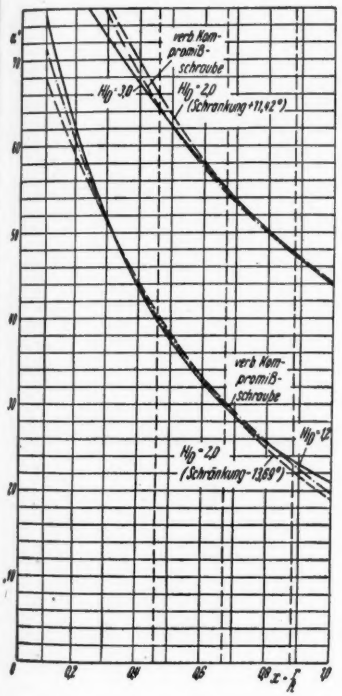

Abb. 11 (links). Steigungswinkelverlauf zweier Schrauben konstanter Steigung und je einer Kompromiß-Verstellschraube mit einer bei Mittelstellung konstanten Steigung bzw. mit ausgeglichenem Steigungsverlauf.

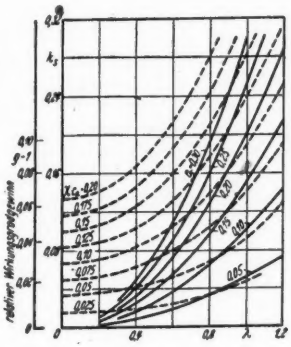

Abb. 12 (rechts). Blattbreitenverhältnis von Luftschrauben und Wirkungsgradgewinn bei Gegenlaufigkeit.

FIG. 11.

(Left.) Distribution of pitch angle of two screws of constant pitch and of a compromise v.p. airscrew with a constant pitch at mean adjustment and with balanced pitch distribution.
Verb. Schraube = compromise v.p. airscrew.
Schränkung = setting angle + 11.42°.

FIG. 12.

(Right.) Blade width ratio of airscrews and gain in efficiency with opposed rotation.
Relativer Wirkungsgradgewinn = relative gain in efficiency.

This is a large value. Certainly some part of this torque is taken up by the wings, which act as a kind of guide vane system, but a considerable proportion nevertheless becomes free. Now if the screws have the same sense of rotation, these free moments will act in the same sense and may give rise to considerable

troubles in flight. If the rotations of the screws or the engines are in opposite senses, the free torques of each screw will neutralise each other.

In the case where the airscrews are mounted on a common shaft we may count on the recovery of the twist energy otherwise contained in the slipstream. For this, however, the loss in axial energy will be greater since the cross-section of the slipstream will be only half that obtained with airscrews of the same diameter but mounted on separate shafts. Mostly therefore no gain is to be expected. The extent to which the aerodynamical qualities of the airframe might be improved by dispensing with special engine nacelles when using screws with opposite rotation mounted on a common shaft, will not be discussed in the present paper. The prevention of the large free torques through screws with opposite rotation even though not mounted on a common shaft might be extremely desirable from the point of view of pilotage with the anticipated reduction of the r.p.m. and increase in power.

If, in view of the magnitude of the power to be disposed of and the adjustment forces, the airscrew blade area (solidity) must be large and divided into a large number of blades, such an airscrew may be constructed as a pair of screws in opposing rotation. With the same diameter, the axial and frictional losses will then be the same as with a single screw of the same performance and r.p.m. By avoiding the twist losses the efficiency, however, will differ by the factor

$$g=\left(\frac{1}{\eta_d}\right)=2/\{1+\sqrt{(1-k_{sm})}\}$$

$$=1+k_{sm}/\{1+\sqrt{(1-k_{sm})}\}^2 \qquad \left(k_{sm}=\lambda^2\frac{e_s}{(r_m/R)^2};\ (r_m/R)^2\sim 0.6\right)$$

The relative gain in efficiency is thus:—

$$\frac{\Delta\eta}{\eta_{single}}=\frac{\eta-\eta_{single}}{\eta_{single}}\frac{\eta_a-\eta_a\cdot\eta_d}{\eta_a\cdot\eta_d}=g-1+\frac{1}{\eta_d}-1=k_{sm}/\{1+\sqrt{(1-k_{sm})}\}$$

This gain is shown graphically in Fig. 12. Fig. 12 also shows the values for

$$\chi c_a=\frac{k_s}{\{(2/3)(1+\lambda^2)^{3/2}\}}$$

Selecting c_a for any working condition, we can then find with the aid of k_s and λ the blade width ratio:—

$$\chi=\frac{(zt_m)}{(2\pi R)}$$

and hence, with the desired number of blades, the blade width necessary for the disposal of the power.

V. Summary.

With the increase in engine power and speed special attention must be given to the question of the airscrew when the tip speed approaches the speed of sound. It will even become necessary to reduce the peripheral speed. Model experiments show that screws, even with different distribution of the pitch angle over the radius are roughly of equal value. In particular screws of very large pitch may be well adapted to varying conditions of operation by suitable adjustment. With reduction of the peripheral speed and simultaneous increase of the diameter the r.p.m. values become small and with simultaneous increase of power the free torques become large. With twin-engined aeroplanes it is therefore convenient to use screws and engines in opposite rotation.

THE ROYAL AERONAUTICAL SOCIETY

WITH WHICH IS INCORPORATED THE INSTITUTION OF AERONAUTICAL ENGINEERS.

SEVENTY-SEVENTH ANNUAL REPORT OF THE COUNCIL, 1941-1942.

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REPRESENTATIVES ON OTHER BODIES.

The following were appointed as the Society's Representatives on other bodies:—

Advisory Committee for Aeronautical Engineering of the City and Guilds of London Institute: Professor F. T. Hill and Captain J. Laurence Pritchard.

Advisory Council of the Science Museum: Lord Sempill.

Air League of the British Empire: Mr. W. O. Manning and Mr. Griffith Brewer.

Association of Special Libraries and Information Bureaux: Mr. J. E. Hodgson (Honorary Librarian).

British Standards Institution, Aircraft Committee: Major R. H. Mayo and Dr. H. C. Watts.

British Standards Institution, Committee on Symbols and Abbreviations Used in Engineering: Dr. H. Roxbee Cox.

British Standards Institution Technical Committee on Aircraft Nomenclature: Professor L. Bairstow, Captain J. Laurence Pritchard.

British Standards Institution, Units and Technical Data Committee: Lieut.-Col. W. Lockwood Marsh.

Engineering Joint Council: Mr. C. R. Fairey.

Engineering Joint Council, Special Educational Representative: Professor G. T. R. Hill.

The Guild of Air Pilots and Air Navigators of the British Empire, Sefton Brancker Memorial Fund Committee: Captain P. D. Acland.

Joint Standing Committee with the Society of British Aircraft Constructors and the Royal Aero Club: Mr. E. F. Relf, Lord Sempill, Lieut.-Col. J. T. C. Moore-Brabazon, Air Vice-Marshal R. M. Hill, Mr. W. C. Devereux.

National Central Library: Mr. J. E. Hodgson (Honorary Librarian).

Professional Classes Aid Council: Lord Sempill.

Seagrave Memorial Fund Committee: Mr. C. R. Fairey.

Ministry of Labour, Engineering Advisory Committee: Sir Roy Fedden, Captain J. Laurence Pritchard.

Institution of Mechanical Engineers, National Certificates and Diplomas in Mechanical Engineering: Sir Roy Fedden and Professor F. T. Hill.

MEMBERSHIP.

The Membership of the Society for 1941, the second full year of the War, shows a net increase over 1940.

The rapid expansion of the Aircraft Industry and the Royal Air Force has brought with it an increased number of applications for membership. Under the Rules for Associateship at least three years' experience is required in aviation, and under those for Associate Fellowship at least five years' experience is required. Although many of those who apply are qualified from the examinations point of view, a large number have only entered aviation since the outbreak of war and are therefore not eligible for technical membership. The Council have no present intention of relaxing the rules for technical membership. Experience of the last war showed that many who joined during the war had no intention of staying in aviation afterwards, and there was a very considerable drop in membership following the end of the war in 1918.

The Council feel that it is more important than ever to safeguard the standard of Associate Fellowship now, so that its high standard will be in no way lessened when the war is over.

MEMBERSHIP OF THE SOCIETY, DECEMBER 1941.

	No. of Members.	Honorary and Life Members.	Suspended Members.	Grand Totals.
Fellows	215 (216)	23 (21)	4 (7)	242 (244)
Associate Fellows ...	1060 (973)	6 (5)	66 (45)	1132 (1023)
Associates	346 (323)	3 (3)	28 (32)	377 (358)
Graduates	164 (137)	— —	7 (5)	171 (142)
Companions	107 (117)	10 (10)	13 (11)	130 (138)
Founder Members ...	17 (17)	1 (1)	1 (1)	19 (19)
Students	557 (556)	— —	74 (74)	631 (630)
Temporary Honorary Members	— —	17 (33)	— —	17 (33)
Totals	2466 (2339)	60 (73)	193 (175)	2719 (2587)

NOTE.—Figures in brackets give the membership as at December, 1940.

DONATIONS.

The Council have to thank the Air Ministry for the seventeenth year in succession for their grant of £250 to the Funds of the Society, and the Society of British Aircraft Constructors for a similar grant over a similar period.

In the report of the Council for 1939-1940 a history was given of the initiation and progress of the Endowment Fund. Many generous gifts, spread over seven years, have been made, and the table below shows the progress of the Fund.

	£	s.	d.
December, 1926	575	0	0
December, 1927	597	2	0
December, 1928	1,047	18	0
December, 1929	1,077	6	0
December, 1930	1,265	10	0
December, 1931	1,935	10	0
December, 1932	2,196	2	0
December, 1933	9,716	19	5
December, 1934	10,131	14	11
December, 1935	10,895	10	7
December, 1936	11,138	16	7
December, 1937	11,474	3	7
December, 1938	12,211	12	11
December, 1939	51,048	14	6
December, 1940	64,740	17	9
December, 1941	78,616	14	4

SOCIETY'S HEADQUARTERS.

The Society has continued throughout the year to function from its Headquarters, 4, Hamilton Place. Half the furniture, and approximately half the Library, have been moved into storage in the country. Further damage was done to the building at the beginning of the year, by bombs dropping close by. This damage was chiefly the blowing in of windows, and a report from the architect shows the building itself was not damaged structurally.

WAR ACTIVITIES.

It is not possible to give a full account of the work of the Society at the present time, as much of it comes under the Official Secrets Act.

The Society is represented on or by a number of important committees which are actively concerned with the war effort and the results of their work have proved of considerable value.

From time to time meetings of the Society have been held on Sunday afternoons. Notices of the intention to hold these meetings is given in the Journal and only those members who signify their intention to attend have received notice in advance of the exact day and meeting place.

The following meetings were held in 1941 :—

Subject.	Chief Speakers.	Date.
Civil Aviation	Dr. H. Roxbee Cox	14th September.
Drag Reduction	W. G. A. Perring	12th October.
Application and Correlation of Wind Tunnels and Full-Scale Testing	D. L. Ellis and R. H. Francis	2nd November.
The Design of Controls ...	H. B. Irving	7th December.

Further meetings are being arranged and members should watch the notices in the Journal.

In addition to the above meetings a number of other meetings were held, under the Official Secrets Act, in various parts of the country on subjects of direct interest to air problems which had arisen from the experience of the war.

ANNUAL GENERAL MEETING, 1941.

The following is an abbreviated report of the Annual General Meeting of the Society, held on Saturday, March 29th, 1941, in the Offices of the Society at 4, Hamilton Place, W.1.

In the Chair: Professor L. Bairstow, C.B.E., F.R.S., F.R.Ae.S. (Vice-President).

Present: Miss Agnes Baden-Powell (Companion), Mr. R. F. Bailey (Associate Fellow), Mr. J. D. Campbell (Associate Fellow), Mr. T. W. Clavell (Associate Fellow), Dr. H. Roxbee Cox (Fellow), Mr. E. C. Gordon England (Fellow), Mr. A. G. Forsyth (Fellow), P./O. D. Hilton Grundy (Associate Fellow), Mr. Bruce Foster (Associate Fellow), Mr. W. J. Gessay (Associate), Mr. D. F. Horne (Associate Fellow), Mr. R. Borlase Matthews (Fellow), Mr. P. G. Masefield (Associate Fellow), Mr. N. Nicholas (Fellow), Mr. H. N. Schofield (Associate Fellow), Major B. W. Shilson (Fellow), Mr. F. J. Thompson (Associate Fellow), Mr. A. Hessell Tiltman (Fellow), Mr. M. H. Volk (Fellow), Mr. L. A. Wingfield (Associate), Solicitor, Mr. J. A. C. Williams (Graduate), Squadron Leader Yangos (Associate Fellow), Mr. P. C. Young (Associate Fellow).

In attendance: The Secretary and Miss Barwood.

1. The Secretary read the Notice convening the Meeting.

2. The Report of the Scrutineers for the Ballot for new Council resulted in the election to Council of the following:—

Mr. A. Gouge.
Major F. B. Halford.
Professor F. T. Hill.
Professor G. T. R. Hill.
Lieut.-Col. J. T. C. Moore-Brabazon.
Dr. A. G. Pugsley.
Mr. N. E. Rowe.
Mr. F. M. Thomas.
Dr. H. C. Watts.
Mr. R. T. Youngman.

3. It was proposed by Dr. Roxbee Cox and seconded by Mr. L. A. Wingfield that Messrs. Price, Waterhouse be re-appointed Auditors for the ensuing year. The proposal was carried unanimously.

4. The 76th Annual Report of the Council was passed for printing without comment.

The Chairman called upon members to raise any questions they wished on the work and policy of the Society.

Mr. Scott Hall asked if it were possible to hold meetings of the Society in London or elsewhere.

The Secretary explained the difficulties of censorship, accommodation, and the scarcity of subjects for discussion. Practically the only possible subject was that of Civil Aviation, other subjects being quite out of range of realities. He explained how the Society was doing its best under present difficulties.

Professor Bairstow said that if Mr. Scott Hall had any particular subjects in his mind the Council would be very glad to consider them. He said the value of the informal discussions already held lay in the fact that they were held under

conditions of secrecy which allowed a freedom of discussion not possible at an ordinary meeting.

Mr. Scott Hall said that as the vast majority of members were engaged on work for the Ministry of Aircraft Production or the aircraft industry they would automatically come under the Secrecy Act.

Professor Bairstow said he considered the question of secrecy was a pity and it would be a good thing if people could get together and discuss their common problems. He thought it might be possible to hold more meetings if members were willing and able to attend.

Mr. N. Nicholas (Fellow) asked if the Society could help the A.T.C. as they were short of officers and organisers, and the Secretary replied that at the outset he had been in touch with Air Commodore Chamier and offered all the facilities the Society could afford and was told we should be called upon when wanted.

5. Mr. P. G. Masefield, Associate Fellow, said he would like to propose a vote of appreciation to the staff for their help during the year. He was in a position to know just how helpful they had been. The proposal was seconded by Mr. S. Scott Hall.

6. The meeting then closed.

PRESIDENT.

Mr. Griffith Brewer, Hon. F.R.Ae.S., was elected President of the Society for the year October, 1941-September, 1942.

VICE-PRESIDENTS.

The following were elected Vice-Presidents of the Society for the year 1941-1942:—

Professor L. Bairstow, C.B.E., F.R.S., F.R.Ae.S.

Mr. W. C. Devereux, F.R.Ae.S.

Lieut.-Col. the Rt. Hon. J. T. C. Moore-Brabazon, M.C., F.R.Ae.S., M.P.

MEDALS AND AWARDS.

The Council again decided to make no awards for the year, with the exception of the Elliott Memorial Prizes and the Major Baden-Powell Memorial Prizes.

ELLIOTT MEMORIAL PRIZE.

The Elliott Memorial Prize was awarded to: L. A. C. Hirons, of Halton.

The Baden-Powell Memorial Prize was awarded to: Mr. W. J. Strang and Mr. H. Wilson.

HONOURS.

The following members were recipients of Honours during the year:—

Knighthood.—A. H. R. Fedden, D.Sc., M.B.E., M.I.A.E., M.S.A.E., Fellow.

Professor B. Melvill Jones, C.B.E., A.F.C., Fellow.

C.B.—C. J. Stewart, O.B.E., M.I.Mech.E., Fellow.

C.B.E.—Air Vice-Marshal J. E. A. Baldwin, C.B., D.S.O., O.B.E., Associate Fellow; R. H. Dobson, Fellow; Group Captain L. M. Iles, A.F.C., Associate Fellow; A. P. Rowe, Fellow.

M.B.E.—Flight Lieut. D. B. G. Miles, Student.

A.F.C.—Acting Squadron Leader A. M. Jardine, Student; Wing Commander G. E. Watt, B.Sc., D.I.C., Associate Fellow.

SOCIETY OF BRITISH AIRCRAFT CONSTRUCTORS' SCHOLARSHIPS.

The Scholarships Selection Committee of the Society of British Aircraft Constructors and the Royal Aeronautical Society made awards of S.B.A.C. Scholarships to the following:—

R. G. Aldred.
P. F. Crawley.
J. Radford.
D. K. Saunders.
L. Wookey.

The Awards, now in their seventh year, have had most satisfactory results. The regular reports from firms of the progress of those awarded Scholarships show that the scheme has been thoroughly worth while.

It may be recalled that these Scholarships are tenable for a period of four years. Holders of Scholarships are given a thorough workshop and theoretical training and undertake to sit for the Associate Fellowship Examinations of the Society, or an exempting examination.

WILBUR WRIGHT MEMORIAL LECTURE.

The 29th Wilbur Wright Memorial Lecture was delivered on June 17th, 1941, by Mr. J. Trippe, President, Pan American Airways System, on "Ocean Air Transport." A full report was published in the Journal of the Society for September, 1941.

BRANCHES.

There are sixteen branches of the Society most of which have been compelled, owing to the heavy strain of war work, to curtail their activities. Most of them, however, have kept a skeleton organisation going so as to function fully after the war is over.

GRADUATES' AND STUDENTS' SECTION.

The Officers of the Section for the year 1941 were as follows:—

Chairman: Dr. H. C. Watts, M.B.E., M.Inst.C.E., F.R.Ae.S.
Vice-Chairman: Mr. J. P. Smith.
Honorary Secretary: Mr. J. A. C. Williams, B.Sc.
Committee: Messrs. F. Horn, G. M. M. Magill, P. G. Masefield (ex-officio), F. W. Page, A. R. Pitt, H. Roberts, H. Udall, R. T. Wall.

Despite the difficulties caused by war conditions a number of visits, lectures and discussions were arranged as follows:—

Lectures and Discussions.

(1) Annual General Meeting, 2nd July, 1941, followed by a discussion on a paper by Mr. S. Camm, C.B.E., F.R.Ae.S.

(2) 31st July, 1941—Discussion on "Light Aeroplanes." Chairman and Introducer, Mr. F. F. Crocombe, B.Sc., A.C.G.I., D.I.C., A.F.R.Ae.S.

(3) 27th August, 1941.—Discussion on "The Training of Aeronautical Engineers." Chairman and Introducer, Professor F. T. Hill, F.R.Ae.S.

(4) 11th September, 1941.—Lecture on "Planning for Production." Lecturer, Mr. J. V. Connolly, B.E., A.F.R.Ae.S.

(5) 28th October, 1941.—Lecture on "Construction and Inspection of Wooden Aircraft." Lecturer, Mr. J. E. Bolton, A.F.R.Ae.S. This lecture was followed by a sound film show, including the Lippisch Air Flow Film.

Average attendance at these lectures was 34.

(*Continued on page* 138.)

THE ROYAL

(Aerial

Balance Sheet,

	£ s. d.	£ s. d.
Share Capital—		
Authorised—		
20 Shares of 1/- each	1 0 0	
999 Shares of £1 each	999 0 0	
	1000 0 0	
Issued—19 Shares of 1/- each, fully paid...		19 0
Sundry Creditors		1253 15 10
Subscriptions and Other Amounts Received in Advance		411 18 5
Staff Pension Fund		515 4 2
Income and Expenditure Account—		
Balance at 31st December, 1940	2928 16 6	
Add—Surplus of Income over Expenditure for year to date ...	1001 0 3	3929 16 9
		£6111 14 2

We report to the Members that we have examined the above Balance Sheet with the Books and are of the opinion that the Balance Sheet is properly drawn up so as to exhibit a true and correct information and the explanations given to us and as shown by the Books of the Society.
3, Frederick's Place, Old Jewry, London, E.C.2.
25th February, 1942.

Income and Expenditure Account

	£ s. d.	£ s. d.	£ s.
			1940 Fi
To Establishment Expenses—			
Ground Rent, Heating, Lighting and Insurance		1601 13 5	(1380 1
,, Office and Staff Expenses—			
Salaries	2332 0 8		(2089
Printing and Stationery	393 2 11		(406
Postages and Telephone	357 16 6		(315 1
Other Charges	931 7 5	4014 7 6	(966
			3777 1
,, Meetings	... ...	48 4 7	(23
,, Library Expenses	... ...	94 13 0	(90 1
,, Examinations—			
Expenses	174 1 10		(140 1
Less Fees Received	108 10 0	65 11 10	(141 1
			(0 1
			Cred
,, Prizes and Donations		5 5 0	(5
,, Legal and Professional Charges		52 10 0	(80 1
,, Staff Pensions Fund...		100 0 0	(100
,, Balance, being Surplus of Income over Expenditure for year carried to Balance Sheet		1001 0 3	(1169 1
		£6983 5 7	

W. C. DEVEREUX, Chairman, Finance Committee.
A. N. D. SMITH, Honorary Accountant.

AERONAUTICAL SOCIETY

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Printed Books, Bindings, Old Prints, etc., at cost, less amounts written off		50 0 0
Stock of JOURNALS *and other Publications*		1 0 0
Investment in and amount due from Subsidiary Company Aeronautical Trusts Limited—		
21 Shares of 1/- each, fully paid, at cost	1 1 0	
Amount due on Current Account	1819 5 7	1820 6 7
Staff Pension Fund—		
Investment, at cost—		
£547 8s. 10d. 2½ % Funding Loan, 1956/61...	501 4 2	
Cash at Bank	14 0 0	515 4 2
Sundry Debtors	... ...	1237 16 2
Cash at Bank and in Hand	... ...	2487 7 3
		£6111 14 2

of the Society, and have obtained all the information and explanations we have required. We view of the state of the Society's affairs as at 31st December, 1941, according to the best of our

(Signed) PRICE, WATERHOUSE & CO.

for the Year ending 31st December, 1941.

	£ s. d.	£ s. d.	£ s. d.	£ s. d. 1940 Figures
By Annual Subscriptions	... ...	5604 16 0		(5428 3 10)
,, Donations	... ...	500 0 0		(500 0 0)
,, Receipts from JOURNAL and Sundry Publications—				
Sales	1460 3 0			(1615 18 11)
Advertisement Revenue	3344 18 3			(2394 6 4)
	4805 1 3			(4010 5 3)
Less Expenditure—				
Printing Costs	3356 12 3			(2580 4 6)
Postages	401 0 5			(334 7 8)
Other Charges	168 19 0	3926 11 8	878 9 7	(398 5 2)
				(£697 7 11)

£6983 5 7

AERONAUTICAL

Balance Sheet,

	£ s. d.	£ s. d.	£ s. d.
Share Capital—			
Authorised—40 Shares of 1/- each		2 0 0	
Issued—21 Shares of 1/- each fully paid			1 1 0
Royal Aeronautical Society Endowment Fund—			
Capital Account—Balance at 31st December, 1940 ...		64647 14 7	
Add Donations received during year		12780 7 3	
Entrance Fees received during year		452 11 0	
		77880 12 10	
Income Account—Balance at 31st December, 1940 ...	93 3 2		
Add—Surplus of Income over Expenditure for year to date	642 18 4	736 1 6	
			78616 14 4
Pilcher Memorial Fund—			
Capital Account—As at 31st December, 1940		99 14 0	
Income Account—Balance at 31st December, 1940 ...	35 7 8		
Add Income for year to date	4 0 8	39 8 4	139 2 4
Usborne Memorial Fund—			
Capital Account—As at 31st December, 1940		109 2 5	
Income Account—Balance at 31st December, 1940 ...	52 6 0		
Add—Income for year to date	3 19 0	56 5 0	165 7 5
Herbert Akroyd Stuart Fund—			
Capital Account—As at 31st December, 1940		688 19 0	
Income Account—Balance at 31st December, 1940 ...	274 6 7		
Add Income for year to date	26 6 10	300 13 5	989 12 5
R.38 Memorial Fund—			
Capital Account—As at 31st December, 1940		978 3 10	
Income Account—Balance at 31st December, 1940 ...	479 7 2		
Add Income for year to date	40 2 3	519 9 5	1497 13 3
Edward Busk Memorial Fund—			
Capital Account—As at 31st December, 1940		449 6 1	
Income Account—Balance at 31st December, 1940 ...	102 8 1		
Add Income for year to date	19 1 10	121 9 11	570 16 0
Wilbur Wright Memorial Fund—			
Capital Account—As at 31st December, 1940		1420 7 9	
Income Account—Balance at 31st December, 1940 ...	137 18 9		
Add Surplus of Income over Expenditure for year to date	5 17 8	143 16 5	1564 4 2
Simms Gold Medal Fund—			
Capital Account—Balance at 31st December, 1940 ...		250 0 0	
Add Profit on realization of Investment		74 15 9	
		324 15 9	
Less—Income Account—			
Deficiency at 31st December, 1940	18 1 6		
Less Income for year to date	2 18 8	15 2 10	309 12 11
Alston Memorial Fund—			
Capital Account—As at 31st December, 1940		245 6 0	
Income Account—Balance at 31st December, 1940 ...	2 3 7		
Add—Income from year to date	5 13 8	7 17 3	253 3 3
			£84107 7 1

We report to the Members of Aeronautical Trusts Limited, that we have examined the above explanations we have required. We are of opinion that the Balance is properly drawn up December, 1941, according to the best of our information and the explanation given to us and as

3, Frederick's Place, Old Jewry, London, E.C.2.
25th February, 1942.

TRUSTS LIMITED

31st December, 1941.

	£	s.	d.	£	s.	d.	£	s.	d.
Royal Aeronautical Society Endowment Fund—									
Leasehold Property at Cost—Less amount written off									
4, 8, and 9, Hamilton Place							10670	0	0
Furniture at cost, *less* depreciation							3740	12	6
Investments at Cost—	£	s.	d.						
£6474 11s. 7d. 3½ % Conversion Loan	6192	5	1						
£4500 3 % War Loan, 1955/59	4497	0	2						
£15103 15s. 3d 3½ % War Loan	14000	0	0						
£10000 2½ % National War Bonds, 1945/47	10000	0	0						
£1000 3 % Defence Bonds	1000	0	0						
£14500 3 % Savings Bonds, 1955/65	14500	0	0						
£629 16s. 4d. London County Council 2¾ % Stock, 1960/70	600	0	0						
£2367 12s. 7d. Manchester 3 % Redeemable Stock, 1952/55	2388	12	11						
£4100 L.N.E. Rly. 3 % Debenture Stock	3162	6	3						
£3100 L.M.S. Rly. 4 % Debenture Stock	3162	19	9				59503	4	2
Cash at Bank							1112	9	0
Amounts due for refund of Income Tax, etc. ...							5359	4	3
							80385	9	11
Less—Amount due to Aerial Science Limited ...	1764	11	7						
Amount owing for Legal Charges	4	4	0				1768	15	7	78616	14	4
Pilcher Memorial Fund—									
£115 6s. 10d. 3½ % War Loan at cost							116	5	0			
Cash at Bank							22	17	4	139	2	4
Usborne Memorial Fund—									
£113 3½ % War Loan at cost							114	11	1			
Cash at Bank							50	16	4	165	7	5
Herbert Akroyd Stuart Fund—									
£683 1s. 0d. 3½ % War Loan at cost							698	19	0			
£250 3 % Defence Bonds							250	0	0			
							948	19	0			
Cash at Bank							40	13	5	989	12	5
R.38 Memorial Fund—									
£1048 11s. 2d. 3½ % War Loan at cost							1098	18	10			
£350 3 % Defence Bonds at cost							350	0	0			
							1448	18	10			
Cash at Bank							48	14	5	1497	13	3
Edward Busk Memorial Fund—									
£284 4s. 2d. 3½ % War Loan at cost							284	4	2			
£217 London Transport 4½ % "A" Stock, at cost							199	4	6			
							483	8	8			
Cash at Bank							83	4	5			
Amount due for refund of Income Tax							4	2	11	570	16	0
Wilbur Wright Memorial Fund—									
£1246 18s. 1d. 3½ % Conversion Stock, at cost							1000	0	0			
£530 2½ % National War Bonds, 1945/47, at cost							530	0	0			
							1530	0	0			
Cash at Bank							84	4	2			
							1614	4	2			
Less—Amount owing to Aerial Science Limited							50	0	0	1564	4	2
Simms Gold Medal Fund—									
£300 3% Defence Bonds, at cost							300	0	0			
Cash at Bank							9	12	11	309	12	11
Alston Memorial Fund—									
£252 14s. 10d. 3 % War Loan 1955/59 at cost							250	0	0			
Cash at Bank							6	5	1			
Amount due for refund of Income Tax							1	12	2			
							257	17	3			
Less—Amount owing to Aerial Science, Limited							4	14	0	253	3	3
Cash in Hand										1	1	0
										£84107	7	1

Balance Sheet with the books of the Company and have obtained all the information and so as to exhibit a true and correct view of the state of the Company's affairs as at 31st shown by the books of the Company.

(Signed) PRICE, WATERHOUSE & CO.

AERONAUTICAL

INCOME & EXPENDITURE ACCOUNTS

Royal Aeronautical Society

	£	s.	d.
To Legal Charges	46	4	6
,, Amortisation of Leasehold Property	485	0	0
,, Depreciation of Furniture	213	15	0
,, Surplus of Income over Expenditure for year carried to Balance Sheet	642	18	4
	£1387	17	10

Pilcher

To Income for year carried to Balance Sheet...	4	0	8
	£4	0	8

Usborne

To Income for year carried to Balance Sheet...	3	19	0
	£3	19	0

Herbert Akroyd

To Income for year carried to Balance Sheet	26	6	10
	£26	6	10

R.38

To Income for year carried to Balance Sheet	40	2	3
	£40	2	3

Edward Busk

To Income for year carried to Balance Sheet...	19	1	10
	£19	1	10

Wilbur Wright

To 1941 Award	50	0	0
,, Surplus of Income over Expenditure for year carried to Balance Sheet	5	17	8
	£55	17	8

Simms Gold

To Income for year carried to Balance Sheet	2	18	8
	£2	18	8

Alston

To Income for year carried to Balance Sheet...	5	13	8
	£5	13	8

TRUSTS LIMITED

FOR THE YEAR ENDED 31st DECEMBER, 1941.

Endowment Fund.

	£ s. d.
By Interest on Investments (less Tax)	1093 18 5
,, Refund of Income Tax	293 19 5
	£1387 17 10

Memorial Fund.

By Interest on Investments (gross)	4 0 8
	£4 0 8

Memorial Fund.

By Interest on Investments (gross)	3 19 0
	£3 19 0

Stuart Fund.

By Interest on Investments (gross)	26 6 10
	£26 6 10

Memorial Fund.

By Interest on Investments (gross)	40 2 3
	£40 2 3

Memorial Fund.

By Interest on Investments (*less* Tax)...	14 18 11
,, Refund of Income Tax	4 2 11
	£19 1 10

Memorial Fund.

By Interest on Investments (gross)	55 17 8
	£55 17 8

Medal Fund.

By Interest on Investments (gross)	2 18 8
	£2 18 8

Memorial Fund

By Interest on Investments (less Tax)...	4 1 6
,, Refund of Income Tax	1 12 2
	£5 13 8

Visits.

(1) 30th August, 1941.—A.T.A. Headquarters.

(2) 26th October, 1941.—Messrs. Hawker Aircraft Limited, Works.

(3) 8th November, 1941.—Messrs. Handley Page Limited, Aerodrome.

Visits were carried out under the auspices of the Ministry of Aircraft Production, but these facilities have since been withdrawn.

ASSOCIATE FELLOWSHIP EXAMINATIONS.

The results of the Associate Fellowship Examinations held in May and December, 1941, were published in the Journal for July, 1941, and March, 1942.

MEMBERS ELECTED DURING 1941.

The names of members elected in the various grades of the Society during 1941 have been regularly published in the Monthly Notices.

ACKNOWLEDGMENTS.

The Council gratefully acknowledge the gifts of books, photographs, Journals and historical papers from members during the year. All the gifts have been acknowledged, as received, in the Monthly Notices.

FINANCE.

The Income and Expenditure Accounts and Balance Sheets of Aerial Science, Limited, and Aeronautical Trusts, Limited, for 1941, are published in this issue of the Journal.

The Income and Expenditure Account of Aerial Science, Limited, shows an excess of income over expenditure for the year of £1,001 0s. 3d. as against £1,169 1s. 3d. for 1940.

JOURNAL.

The Journal of the Society has maintained its high standard in the face of increasing difficulties due to the war, and a wide variety of papers have been published. Of particular value, during the year, has been the continual publication of the Abstracts from the Scientific and Technical Press and References to Papers, enabling members to keep informed of the contents of papers whose circulation is not so widespread as formerly.

The Income and Expenditure Account of Aerial Science, Limited, gives a summary of the expenditure on the Journal and sundry publications. The sundry publications have been severely cut down in order to conserve paper for the Journal, which is regarded by the Council as the most important publication of the Society at the present time.

The Income and Expenditure of the Journal is as follows. (The figures in brackets are the corresponding figures for 1940.)

	£ s. d.	£ s. d.		£ s. d.	£ s. d.
Printing Costs ...	3356 12 3	(2580 4 6)	Sales	1460 3 0	(1615 18 11)
Postages	401 0 5	(334 7 8)	Advertisements ...	3344 18 3	(2394 6 4)
Other Charges ...	168 19 0	(398 5 2)			
Profit	878 9 7	(697 7 11)			
	£4805 1 3	£4010 5 3		£4805 1 3	£4010 5 3

The accounts show a decrease in sales, due to the stoppage of sales abroad, and an increase in advertisement revenue.

HONORARY TREASURER.

Captain A. G. Lamplugh, F.R.Ae.S., was appointed Honorary Treasurer of the Society on April 30th, 1941.

OFFICERS OF THE SOCIETY.

The Council wish to place on record their appreciation of the work which has been carried on by the Honorary Officers of the Society.

Mr. A. N. D. Smith completes his fourteenth year as Honorary Accountant. He has given most valuable advice and assistance to the Society, especially on questions involving Income Tax.

Mr. L. A. Wingfield, the Solicitor to the Society, has also given valuable advice on Income Tax questions and on those problems which have arisen due to enemy action.

Mr. J. E. Hodgson, Honorary Librarian, has also given the Society valuable assistance throughout the year.

The Council wish particularly to place on record their appreciation of the work of various Committees which have met during the year and advised on the work of the Society.

STAFF.

Upon the permanent staff has fallen the responsibility of carrying on the work of the Society. Much of this work comes under the Censorship and it will not be possible to give details of it for some time to come. The Staff is less than a third of its pre-war size, and in addition to its normal work has also been responsible for fire-watching and A.R.P. work at 4, Hamilton Place.

OBITUARIES.

The Council record with deep regret the deaths of the following members since the publication of the last Council report:—

*Sergeant Frank B. Abbott, Associate.
*Flt. Lieut. H. Bailey, Associate Fellow.
Mr. Charles Alma Baker, C.B.E., Honorary Member.
*Flt. Lieut. R. A. Barnwell, Student.
*Sergeant E. E. Blofield, Student.
*Flt. Sergeant R. B. Broadhurst, Student.
*Squadron Leader H. F. Chester, Companion.
*P./O. C. A. C. Chetham, Student.
Mr. T. W. K. Clarke, Associate Fellow.
*Flt. Sergeant H. E. Cleaverley, Associate.
*G. H. Corbett, Student.
*Lieut.-Col. R. P. G. Denman, Associate Fellow.
*Flt. Sergeant W. H. Downey, Associate Fellow.
*P./O. R. M. East, Student.
*P./O. W. H. Edwards, Student.
*P./O. R. J. Fyfe, Associate Fellow.
*Pilot Officer A. L. Gordon, Student.
*Squadron Leader W. J. Hickey, Associate.
*Flying Officer M. A. F. Hirst, Student.
*Flying Officer D. J. How, Associate Fellow.
*Flying Officer P. J. Jenkins, Associate.
*Miss Amy Johnson, B.A., C.B.E., Associate.
Mr. N. H. J. Johnson, Graduate.
Mr. J. Kenworthy, Associate Fellow.
*Wing Commander R. J. Knights-Whittome, Associate.

*Pilot Officer K. E. Knox, Student.
*Mr. F. R. Longson, Student.
Mr. H. N. Morris, Companion.
Mr. S. R. Parker, Student.
*Pilot Officer J. G. Pippet, Student.
*Mr. A. E. Richards, Associate Fellow.
*T. D. W. Ross, R.A.F., Student.
Mr. P. M. Scott, Associate.
*Pilot Officer I. M. Strachan, Student.
Lord Wakefield, G.C.V.O., C.B.E., LL.D., Hon. Fellow.
*Corporal R. F. Warren, Student.
*Sergt. Pilot D. F. Youldon, Student.

* Killed in action or on active service or by enemy action.

REVIEWS.

Canada's Wings.

By Peter J. Field. John Lane (The Bodley Head) 1942. 4/-

During the last war the leading four Canadian pilots totalled a higher score of enemy machines than any similar group of Allied airmen. It seems as though the Canadians in this war are going to live up to the standard of their predecessors—two of whom, Bishop and Collishaw, still hold important posts in the R.C.A.F. Already, by the end of 1941, they have won nearly 100 D.F.C.'s (three with Bar), the most spectacular performance being that of McKnight, who in a single engagement over Dunkirk shot down four Ju 87's.

The story of their achievements is graphically told in this book (the royalties from which are being donated to the Queen's Canadian Fund for Air Raid Victims). In his preface the author has anticipated the criticism that we would have made: that this is not a complete record but a series of disconnected journalistic sketches, from which a more permanent history will be made at the end of the war. This, as he says, is inevitable at the moment, when " reasons of security " oblige so much of the material to be withheld. Meanwhile, much that is interesting has been revealed: the chapter on the Empire Air Training Scheme, with its description of the " snow-roller " used for surfacing aerodromes in the winter is particularly instructive, and there is a delightful picture of the Norwegian training camp " Little Norway." Not everyone knows that Bader, though an Englishman, was for a time in command of the famous all-Canadian 242 Squadron.

In conclusion, may we suggest that some poet of the Robert Service type writes for these fine flyers a song that is worthy of them? The present effusion, as quoted in this book, shares with " Land of Hope and Glory " the distinction of having one of the worst rhymes in the English language.

Navigation and Meteorology.

By D. Hay Surgeoner. Longmans, Green and Co. 1942. 3/6.

This is a book that has been written a great many times before, but it is rewritten here with a pleasant simplicity that makes it comprehensible to a complete beginner and at the same time useful as a ready-reference for a practising navigator. We meet again our very old friend the Triangle of Velocities with his satellites the Fix, the Running Fix, the Transferred Position Line, the various methods of finding wind direction (Treble Drift, 90°, Drift and Bearing). We are provided with diagrams of Air Speed Indicator (somewhat over-simplified), Altimeter and Compass, and some remarks on compass errors and their correction. The author is somewhat confused about the red and blue poles of a magnet (one slip in this matter has been noticed in the errata, another has not).

" And Meteorology " is dismissed in ten pages. We cannot help being reminded of the entry in the American globe-trotter's diary: " Stopped over one night in Rome, which I understand is not quite long enough." There is an unfortunate tendency in books of this kind to regard Meteorology as a flavouring to Navigation—a few drops to be inserted in the mixture just before removal from the stove—rather than a subject in itself.

Summing up, this book will be useful to Air Cadets or to those who are teaching them, but we cannot help feeling that too many of these semi-technical works are being published.

HOW TO PILOT AN AEROPLANE.

By Capt. Norman Macmillan. George Allen and Unwin, Ltd. 1942. 2/6.

Captain Macmillan is far too experienced a pilot to imagine that any book can teach a man to fly, and, unlike most authors of similar primers, he has the candour to confess it: "Knowledge of the theory and knowledge of flying are rather like two places on the opposite banks of a river," he says: "They need a bridge between them." His purpose is to construct this bridge, and he does it with a deft touch and an admirable economy in words that reveals many years experience both of flying and of writing. We feel throughout that he must have been one of those flying instructors whose pupils remain grateful to them for life. The book is illustrated by a number of first-rate photographs. An excellent present for any air-minded boy.

ARK ROYAL: THE STORY OF A FAMOUS SHIP.

By Sir Herbert Russell and Commander H. Pursey. John Lane, The Bodley Head. 1942. 4/6.

"What's in a name?" asks Shakespeare. The answer, to a seafaring nation, is—a great deal. The *Revenge* and the *Rawalpindi*, the *Victory* and the *Golden Hind*, the three little steamers of the Zeebrugge raid—*Vindictive*, *Iris* and *Daffodil*, the *Cossack* and the *Exeter*, are names that will live for ever in the history of England and in the hearts of all Englishmen. But especially did we love the *Ark Royal*; there was something solid and satisfying about the very name—suggestive of a dowager, matronly queen—that evoked the ship. As the authors so aptly say: "No sailor could grant her beauty, neither could he deny her majesty."

The first *Ark Royal*, we learn from this book, was the *Ark Raleigh*, built at the orders of Sir Walter Raleigh and renamed when she was taken over by the Crown, to become the flagship of Lord Howard of Effingham when he chased the Armada. The second, a seaplane carrier, rendered yeoman service in the Mediterranean during the Great War, and is still in use for experimental work in connection with aircraft, having been re-christened the *Pegasus* when the third *Ark Royal* came into being.

The new *Ark Royal*, laid down in 1935 and completed in 1937, soon earned the reputation of being "the luckiest unlucky craft in the Navy"—for although both she and the aircraft she carried were often involved in minor accidents, these led to no fatalities. This reputation she kept to the end, for when, after the series of hairbreadth escapes that led to the catch phrase: "*Where is the 'Ark Royal'?*" she finally fell victim to a torpedo, only one man of her crew of 1,600 was killed.

This book traces her momentous career from the first days of the war, when the Germans "sank" her with a bomb that, in fact, exploded 15 feet ahead, through the *Graf Spee* hunt, the Norwegian campaign, the Mediterranean—when the Italians "sank" her again, with a bomb that no one on board saw at all—the action of Oran, and the chase of the *Bismarck*—when aircraft from the *Ark Royal* fired the torpedoes that delayed the German ship until our cruisers could come up with her; until the final surprise attack off Gibraltar, when a single torpedo sent her to the bottom. It is a fine story, finely told, and its lesson is summed up in the opening sentence: "Wherever the English language is spoken, and even in wide realms where it is not, the name of *Ark Royal* has become a rich-sounding synonym for valour and daring which all the buffoonery of Teutonic propaganda merely served to illuminate with the ultimate lustre of truth."